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Mathematics Anxiety in Ninth-Grade Pre-Algebra

Jacquelyn D. Tretter
Western Kentucky University, JacquelynSmiles@gmail.com

MATHEMATICS ANXIETY IN NINTH-GRADE PRE-ALGEBRA

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Jacquelyn D. Tretter

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MATHEMATICS ANXIETY IN NINTH-GRADE PRE-ALGEBRA

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Dr. Sharon Spall, Director of Specialist Project

Dr. Ric Keaster

Dr. William R. Schlinker

Dean, Graduate Studies and Research 24-May-2012 Date

I dedicate this thesis to my Mom who believes in me,

to my Dad who knows I can do it,

and to Dr. Sharon Spall,

who helped me through the process with amazing patience.

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TABLE OF CONTENTS

MATHEMATICSEMATICS ANXIETY IN NINTH-GRADE PRE-ALGEBRA

Jacquelyn D. Tretter May 2012 62 Pages

Directed by: Dr. Sharon Spall, Dr. Ric Keaster, and Dr. William R. Schlinker

Dept. of Educational Admin., Leadership & Research Western Kentucky University

In this qualitative action research study, five lower-achieving freshman pre-algebra students in a rural high school were interviewed about mathematics anxiety. The subjects ranged in age from 13 to 15 years and included three boys and two girls, of which one was Hispanic, one was African-American, and three were Caucasian. These students had tested below the fourth-grade level in mathematics during their eighth-grade year and were placed in special pre-algebra classes, which met for 30 additional minutes each day and progressed with more depth, but at a slower pace.

The researcher employed personal interviews to answer the research question: How do students describe and cope with mathematics anxiety? The researcher utilized the constant comparative method to analyze data and developed the following seven categories: setting and background information; self-image; mathematics difficulties; success in mathematics; support for learning; teacher support; and coping techniques, which was the context of the students' anxiety. While they have encountered some success in mathematics, the descriptions of support from family and student friends, along with teacher support, explain how these students' cope with the anxiety.

When the students talked positively about mathematics, they discussed activities that made mathematics fun or enjoyable. However, these participants also spoke of negative mathematics experiences as early as the first grade. A poor self-image, as it

relates to a student's mathematical knowledge, affects current learning. Past negative perceptions appeared to contribute to their defeat.

The findings coincided with previous research that mathematics anxiety is negatively related to mathematics achievement. Students reported gains from hands-on activities, facilitative teaching, teacher encouragement, additional assessments, and goal settings, but interview data suggested they had mostly given up on getting much better in mathematics, because they thought they were not going to succeed. They stopped trying and giving up was their way of coping.

Introduction

Students' educational experiences include numerous subjects and content areas. Educators in content areas often plan together to promote success in areas such as mathematics and reading. In fall 2007, such a task force met in a community located in the south central part of the United States to support positive educational experiences. This task force included a school district's mathematics coaches, administrators from a high school, and four mathematics department representatives from the local university. Many comments centered on how students seem underprepared to enter their college mathematics classes. Of the incoming Fall 2008 freshman class at this local university, approximately, 60% needed to enroll in at least one remedial mathematics class and of the remedial students approximately 75% did not have the basic sixth-grade mathematics skills (Mathematics Coach, personal communication, February 6, 2009).

Enrollment in college level remedial mathematics classes continues to increase. Locally, the five-year pass rate for the remedial mathematics class DMC055 (Beginning Algebra) at the local community college averages 45% (Mathematics Coach, personal communication, February 6, 2009). Students did not come to higher education equipped with the mathematics skills and knowledge they needed. Even if a student chose a career path unrelated to a college degree, did they have the mathematics skills necessary to live on their own, not to mention manage a budget, credit cards, car payments, mortgages, or apartment payments?

To participate in many careers, mathematical skills remain necessary, even essential to obtain a job. This calls for exploration of what can be done for the students who fall so far behind. One area of concern for all mathematics educators is the

reduction of mathematics anxiety at any grade level (Bonnstetter, 2007). Bonnstetter suggests that the roots of mathematics anxiety begin in middle and elementary grades. Wherever it starts, mathematics anxiety must be dealt with and at the very least decreased for the student to succeed in the future.

In the research literature, the findings indicate that educators believe mathematics anxiety is inversely and moderately related to mathematics achievement (Dahmer, 2001). Mathematics anxiety filters out students who might otherwise attempt advanced mathematics courses and careers involving mathematics (Dahmer). Thus, it is important to investigate students' anxiety and coping mechanisms.

Problem

Learning mathematics of any kind may bring thoughts of dread to the mind of some students. As students struggle to learn the concepts of mathematics, their efforts fall victim to anxiety, potentially leading to repeated failure, lack of basic skill knowledge, and additional educational stumbling blocks. Over and over students repeat, "I am just not good at mathematics." For nine years, the researcher has been drawn to teaching "lower level" or less skilled student. Mathematics, in general, has been very difficult for them.

Recently, in tracking students for placement in a high school pre-algebra mathematics class, over 40 freshman students' mathematics skills were found to be at or below the fourth-grade level. Students feel incompetent in their mathematics ability, and teachers, as well as students, ask what could help them succeed.

Research Question

How do students describe and cope with mathematics anxiety?

Purpose of the Study

The purpose of this study was to ask lower-level, ninth-grade, pre-algebra students to describe their own mathematics anxiety and how they cope with their anxiety. The study investigated students' experiences with mathematics that resulted in mathematics anxiety.

Significance of the Study

Teachers want to know that their efforts result in positive outcomes for students. Data and information gained through this study will guide the researcher and others to teach mathematically anxious students more effectively. The study will also provide information on what processes or teaching strategies may work best for students and specifically, any classroom activities that increase or decrease their anxiety as related to learning mathematics. Then activities that may help the student learn could be incorporated into lesson plans and procedures.

Limitations

The previous relationship between the researcher and the student participants may impact the findings of the study. However, the students may not have participated at all had the researcher been totally unknown to them. Only these participants could answer the research question formed by this researcher. Additionally, the small number of participants limited the amount of data available for analysis.

Discussion of Pertinent Terms

Anxiety can relate to many different things, but generally people associate it with an intense dread or apprehension about something (New Webster's Dictionary, 1990).

Mathematics anxiety is often defined as a feeling of tension, apprehension, or fear that interferes with one's performance in mathematics (Hafner, 2008). Anxiety specific to mathematics is one of the variables most commonly associated with underachievement and has been shown to hinder a student's ability to benefit from instruction (Nasser & Birenbaum, 2005). Mathematics anxiety is described as, "feeling tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide array of ordinary life and academic situations" (Bonnstetter, 2007, p. 11).

Self-efficacy has been defined as an individual's belief regarding his/her performance capabilities in a particular context or a specific task or domain (Nasser & Birenbaum, 2005). It has been further suggested that individuals' efficacy modifies personal expectations and becomes a major determinant for goal setting, activity choice, willingness to expand effort, and persistence (Nasser & Birenbaum).

Literature Review

Introduction

The accumulated research is divided into three topic areas: anxiety related to mathematics achievement; causes/precursors of mathematics anxiety; and reduction or coping mechanisms. These studies and papers provide background information for this study. They were used to guide the research study and create the research question: How do students describe and cope with mathematics anxiety?

Mathematics Achievement

Nasser and Birenbaum (2005) studied structural models of relationships to gather quantitative results from 478 eighth-grade mathematics students (average age 15 for 231 females and 247 males) in Israel. The study included two classrooms from schools that represent the spectrum from low, medium, and high levels of achievement. Nasser and Birenbaum studied five learner-related variables: self-efficacy, beliefs, gender, attitudes, and anxiety (as related to mathematics achievement).

Through assessment tests, surveys, and Likert scale questionnaires, researchers asked questions from the following five areas: mathematical achievement, epistemological beliefs, mathematics self-efficacy, attitude toward mathematics, and mathematics anxiety. The variables and instruments used in the study started with a national mathematics assessment test, which covered curriculum core content and measured mathematics achievement. This 34-item test included nine multiple-choice and 25 open-response/short-answer questions. The mean score of all test items measured mathematics achievement (Nasser & Birenbaum, 2005).

For the study of epistemological beliefs, participants answered four items with a 5-point Likert scale (1-*strong disagreement* to 5-*strong agreement*). This test, designed by the researchers, concerned the nature of mathematical knowledge (sample item: *Mathematics is a logical system by which we can explain real-life phenomena*). Students with higher scores understood or appreciated the complexity of mathematics (Nasser & Birenbaum, 2005, p. 284).

Evaluating mathematics self-efficacy involved answering 11 items (5-point Likert scale, 1-*strongly disagree* to 5-*strongly agree*) on how the participants regard their performance capabilities in mathematics. One example stated, "I can solve any word problem if I try harder" (Nasser & Birenbaum, 2005, p. 284). In this study participant's attitude toward mathematics was determined with three questions about liking mathematics, mathematics importance, and if it was easy. Students chose the most correct agreement on the Likert choices. Lastly, mathematics anxiety was judged by answering 13 questions about the participants' perceived anxiety toward mathematics (1-*low anxiety* to 5-*high anxiety*). Participants with higher scores indicated higher anxiety (p. 285). The study found self-efficacy to have the most influence on achievement in mathematics. Stronger self-efficacy resulted in more positive attitudes and less anxiety. They stated that self-efficacy could be positively influenced through instruction/strategies.

Hafner (2008) found similar results as Nasser and Birenbaum (2005), and he concluded that self-efficacy was related to mathematics anxiety and achievement. Hafner's quantitative study of 124 eighth-grade mathematics students specifically examined self-efficacy as connected to mathematics anxiety and achievement. The study

suggests a decline in academic self-efficacy beginning in middle school. Hafner said students with lower self-efficacy may find it more difficult to self motivate, have lower expectations, and may give up more quickly.

Hafner's (2008) study utilized an adolescent rating scale for mathematics anxiety and a mathematics self-efficacy scale to measure the levels of mathematics anxiety. Study participants chose on a 5-point Likert scale what best described their stress or nervousness ranging from 1-*not at all* to 5-*very much*.

The mathematics self-efficacy scale Hafner (2008) administered measured the participant's self-belief in their ability to answer the mathematics problem correctly. Students tried to solve 20 grade-appropriate algebra problems, while recording their confidence in the correctness of their answer. Study participants answered with an 8-point Likert scale ranging from 1-*not confident at all* to 8-*completely confident* (Hafner, p. 45). The conclusions from Hafner's research mirrored his expected findings: 1) Mathematics anxiety negatively correlated with mathematics self-efficacy; 2) Mathematics anxiety negatively correlated with achievement; and 3) Mathematics self-efficacy positively correlated with achievement. Thus, as students' levels of mathematics anxiety increased, their levels of mathematics self-efficacy would decrease; as students' levels of mathematics anxiety increased their levels of mathematics achievement would decrease; and as students' levels of mathematics self-efficacy increases, their levels of mathematics achievement would increase. Results of the analysis were statistically significant, indicating that mathematics self-efficacy predicts achievement more than beyond the predictive ability of mathematics anxiety and affects the relationship between mathematics anxiety and achievement.

In 1999 Bonnstetter (2007) surveyed 341 students using the mathematics anxiety survey. Then the boys and girls (16 students) with the highest and lowest anxiety levels were then interviewed. Seven years later in Bonnstetter's follow-up study, 11 of the original 16 middle-grade students again completed the mathematics anxiety survey. The Critical Incident Technique again guided the interview part of the study. The follow-up study netted a weak correlation on the survey. The interview examined events that may have impacted mathematics anxiety levels over time.

Four of five "anxious" students improved their survey scores, and one student's score remained the same. The one student who remained the same said fourth grade was a turning point in her mathematics improvement. The students whose scores improved suggested one-on-one teacher's assistance and that a positive learning environment encouraged positive improvements. They told of memorizing "to get by" but large amounts of memorization became difficult for them. These students favored visual, hands-on learning, and direction from the teacher as important as they progressed through their textbook.

Six original study participants classified with "low mathematics anxiety" retested with the mathematics anxiety survey. Three scored higher (increased mathematics anxiety) and three scores did not change (similarly low mathematics anxiety). These six students stated they did not use memorization to learn mathematics (Bonnstetter, 2007). These students used strong number sense, patterns, and relationships. Mathematics understanding and reasoning helped the students work through mathematics related problems. Just as the mathematics "anxious" students commented, one-on-one teacher

help and detailed explanations, along with group work and positive learning environments, added to positive mathematics self-concepts.

The mathematics anxiety questionnaire and qualitative interview questions uncovered that improvements can result over time in the mathematically anxious students. Study participants emphasized teacher characteristics, mathematics teaching strategies, and instructional styles to promote learning mathematics rather than memorization (Bonnstetter, 2007).

Cates and Rhymer (2003) administered a mathematics anxiety test to 52-college students (average age 20.7, 40 females, and 12 males). The students were divided into low or high anxiety groups. The participants then took a timed test on basic mathematical operations (addition, subtraction, multiplication, division and linear equations). The test results helped Cates and Rhymer investigate anxiety levels as associated with fluency and error rates.

Cates & Rhymer (2003) describe learning mathematical skills through four stages. First, in the acquisition stage, the student must be able to complete the problem with the correct answer without time restrictions. Acquisition is followed by the fluency stage, which means completing the mathematic problems with the correct answer, but more quickly and with less effort. Next, the generalization stage requires the student to complete mathematics problems that are slightly different than the exact way the process was taught. Lastly, the adaptation stage occurs when the student can successfully manipulate the data under several different circumstances (Cates & Rhymer, 2003).

The results of the analysis indicated the stage of learning and revealed differences between the anxiety groups on fluency but not on error rates. The higher anxiety group

had less digits correct per minute than the lower anxiety group but showed no differences in accuracy. Data suggests that mathematics anxiety is related to mathematics performance, but is dependent on the level of the learning stage (Cates & Rhymer, 2003).

Ma (1997) conducted a meta-analysis of 113 primary research studies (which included 82,941 students in 12 grade levels) in order to gage the relationship between attitude toward mathematics and achievement in mathematics at the elementary, middle, and high school levels. The five relationships that resulted were as follows: grade level, ethnicity, sample selection, sample size, followed by date of the primary study. Gender groups did not significantly show a relationship.

Ma (1997) concluded that overall there did not appear to be a relationship between attitude toward mathematics and achievement in mathematics. However, when breaking it down to specific grade levels of junior high through high school, the findings showed a more negative relationship. Ma offered the possibly that students in those grades can better explain and understand their attitude toward mathematics and achievement. Thus, the data suggests there is a small relationship between positive attitude towards mathematics and higher achievement in mathematics and vice versa negative attitude towards mathematics and lower achievement in mathematics.

Causes/Precursors of Mathematics Anxiety

Jayaratne (1987) studied questionnaires answered by over 500 fifth- through twelfth-grade mathematics students and their middle-class working parents. The study asked parents and students about mathematics related attitudes. Topics discussed included the following: self-perceptions of individual mathematics aptitude; ease and effort put forth in mathematics; future use of mathematics; and mathematics classes

planned in the future. The questions measured the students' attitudes toward mathematics. Researchers also asked the parents about mathematics (Jayaratne). The parent questions (563 mothers and 527 fathers) related to their current mathematics ability and whether they liked mathematics. They also were asked about current mathematics difficulties, past experiences, effort, and attitude in high school mathematics. Lastly, they asked about their child's perceptions, ability, difficulty, and effort in mathematics (Jayaratne).

The study targeted parents with some college or college degrees. Eight subgroups of parent education levels and gender relationships were identified. The study expected to find correlations with the same-sex parent and between the higher-educated parent pairs. Significant positive correlations, however, emerged in only one subgroup: mothers and daughters.

The study suggests a mother's mathematics experiences did not affect the child's mathematics experience, except in one group: higher-educated mothers and their daughters (Jayaratne, 1987). The results demonstrate that highly educated mothers not only influenced their daughters' mathematics attitudes but also served as role models.

In another study, Dahmer (2001) researched relationships between a parent's mathematics anxiety and educational level as related to mathematics achievement in their children. Statistical data gathered from 66 families (80 parents and 80 students) consisted of student scores on a standardized achievement test and the scores on the 98-item self-rated mathematics anxiety survey.

With parental consent, achievement scores were acquired from the school district. Research packets given to parents included the mathematics anxiety survey and a

demographic sheet. Completed packets returned to the researcher were scored and entered into a statistical computer program. Dahmer (2001) found parents' mathematics anxiety does not predict a child's mathematics test scores. Gender of the parent did not predict the parent's mathematics anxiety score. Jayaratne's (1987) study found only some female parent influence on their daughter's mathematics ability, while Dahmer found a parent's education level does not predict a child's mathematics test score.

Tocci and Engelhard (1991) conducted an analysis of the data from an international mathematics study. The eighth-grade participants in the study consisted of 3,846 U.S. students and 3,528 Thai students with an average age of 13. Among the U.S. students (2,059 girls and 1,787 boys), Tocci and Engelhard studied attitudes toward mathematics achievement, parental support, and gender.

To be included in the analysis, students had to have completed the year-end eighth-grade mathematics achievement test, an attitude instrument, and a data questionnaire asking additional details not asked on the international mathematics questionnaire. Students missing data from any of these additional study instruments, precluded their inclusion in the study (Tocci & Engelhard, 1991).

When the researchers examined all the data, gender and stereotyping emerged. Gender differences in mathematics were found. Males believed in the idea of the usefulness of mathematics over females. Stereotyping was also found in terms of male successfulness (Tocci & Engelhard, 1991).

Green (1990) studied 132 undergraduate students in Howard University's remedial mathematics program. The study was conducted in the mathematics laboratory at the Center for Academic Reinforcement (CAR). The center offers peer tutoring,

computer assistance, and mini-lectures for students with extensive mathematics deficiencies.

The variables studied by Green (1990) consisted of test anxiety, mathematics anxiety and ability, and teacher feedback on mathematics performance. The research study utilized two anxiety research instruments and six examinations from the CAR-Mathematics department. One instrument measured the levels of test anxiety with 37 true/false items while another scale measured mathematics anxiety related to completing mathematics problems. The instrument utilized 10 positively and negatively worded true/false statements. The researcher also included positive teacher comments on test papers and other personalized encouragement in the study.

Test anxiety and mathematics placement test scores had an effect on mathematics achievement in this study. Instructor comments specific to the error supported student performance in general and on tests, but general scripted or no comments had little effect. Informative critiques from teachers as feedback guided students, increased motivation, and continued to facilitate test performance (Green 1990).

In Godbey's (1997) review of research reports, he discusses symptoms and causes of mathematics anxiety, as well as steps to reduce them. Negative self-talk about mathematics ("I can't do this problem. I could never do mathematics.") may result in a self-fulfilling prophecy ending in failure when attempting mathematics problem solving. Godbey listed other possible causes such as under-preparedness, school absences, parental and teacher influences, and past negative experiences in mathematics.

Myths associated with learning mathematics also need to be overcome. Godbey (1997) listed several myths that could negatively affect mathematics experiences.

Mathematical ability is not inherited. A parent's mathematics ability does not forecast his/her child's mathematics ability. Mathematics is not a "boys are better" subject. Mathematics requires hard work and understanding. Focusing on learning mathematics without understanding may also add to mathematics frustration.

Godbey (1997) concluded that positive results to ease some of these frustrations require dedicated teachers, involved parents, and students who will courageously work to solve the problem. Teachers must work hard to understand their students' knowledge and feelings about mathematics to help students build success and confidence in their mathematics abilities. Students must learn to ask questions that help themselves understand the subject matter. New and creative ways to present the material may alter student opinions about mathematics. Godbey suggests mathematics teachers should try humor and be enthusiastic to motivate and change perceptions about mathematics.

Reducing Mathematics Anxiety or Coping Mechanisms

Peskoff (2000) studied 279 community college students in remedial algebra and pre-calculus classes to identify successful coping strategies for mathematics anxiety. Study participants completed a mathematics anxiety scale that had 20 questions.

Students were also asked to rate 10 mathematic coping strategies. This investigator-designed questionnaire asked about tutoring, relaxation, and even studying more. In addition, 50 faculty members rated the questionnaire coping strategies on how useful they thought the strategies would be to students (Peskoff, 2000).

The study found that students with less mathematics anxiety both utilized and valued a wider array of coping strategies than students with higher mathematics anxiety (Peskoff, 2000). Highly mathematics anxious students preferred utilizing tutoring and

discussions with counselors. However, tutoring and counselor discussion, along with relaxation, were considered the least helpful by all of the students. Males utilized relaxation more than the females (Peskoff). Females relied more on completing homework and letting instructors know they did not understand (Peskoff). Overall, study participants rated and agreed that homework, extra study time, asking questions, and letting the instructor know about difficulties were top picks for better coping (Peskoff). These "approach strategies" directly confront the mathematics anxiety (Peskoff, p. 3)

Shields (2006) worked with 91 college students to produce quantitative and qualitative data on societal influences, parental influences, and teacher influences on mathematics anxiety. Students said anxiety was due to lack of mathematics understanding (78%), and they blamed themselves because they felt responsible. Shields suggests that students need to take control of their learning and attitudes, that attitudes determined their behavior, and that anxiety is a learned response that can be unlearned. Study participants identified five techniques to reduce anxiety: tension/relaxation techniques, visualization, deep breathing, thought-stopping techniques, and overcoming negative self-talk.

Scarpello (2007) discusses suggestions to help students overcome mathematics anxiety that may begin as early as fourth grade. He states that students limit the number of mathematics classes taken in middle school, because they do not like or do not feel confident in mathematics. This could limit classes available to a student in high school and even in college. Scarpello says, "By 10^{th} grade many students stop taking math" (p. 34). As early as middle school, students could be unknowingly limiting their choice of future careers or occupations that require college degrees.

Scarpello (2007) highlights that parents should encourage and support their students to take challenging classes in school. Parents should discuss their student's career choices and investigate school classes that complement that choice. The parent's attention to how their student is progressing in classes such as mathematics and science, helps the student to see a value in them. Parents that show an interest can help build student's interest in a subject.

Teachers also play a large role in noticing mathematics anxiety and encouraging students to succeed. Teachers must implement effective teaching practices to help ease anxiety in the subject area (Scarpello, 2007).

Biller (1996) discusses that students with mathematics anxiety have lower beliefs about their success in mathematics. This can result in the student giving up. Changing negatives attitudes about mathematics can possibly be done through differentiating learning styles. Biller suggests that students fear the subject of mathematics and this fear overtakes the student's true ability. Mathematics anxiety develops over time from many types of experiences where mathematics is associated with negative situations from teaching practices, classroom environment, and lack of variety.

Biller (1996) suggests decreasing mathematics anxiety by integrating other subjects with mathematics. For example, integrating art with the mathematics curriculum will involve the student in the learning. "There is too much math in art and art in math to consider one without the other" (Biller, p. 4). Art can visually represent mathematical concepts and promote student participation during learning.

To help alleviate anxiety, Biller makes four classroom suggestions. Teachers who facilitate collaborative student learning and active participation focus on the student and

promote a student-centered environment. In an effort to decrease mathematics anxiety, Biller (1996) says that classrooms must also connect to the real world in meaningful ways for the learner. The classroom must be a relaxed place where students feel safe to fail and learn from their mistakes. Students must gather information and think through ideas. Computers were offered as another teaching tool for instruction to promote exploration and analysis (Biller).

In a qualitative research study, Morris (2007) administered a pre and post anxiety survey to all students in beginning algebra classes during one semester. The students who showed at least a 10% reduction in anxiety were considered for interviews. The 21 university students (average age 20, 15 females, and six males) who participated answered questions about what they thought most contributed to their success in reducing mathematics anxiety. These participants stated that prior teacher's instructional methods and derogatory comments, along with environmental factors lead to the mathematics anxiety. These students said that they lacked outside help and commented that extended time between mathematics classes (high school to college) contributed to anxiety.

The students suggested that journal writing, calming techniques, group activities, and small but repeated successes helped to reduce anxiety (Morris, 2007). These students noted that the current course instructor employed instructional strategies to promote understanding and maintained a positive learning space where the students were relaxed. The students felt safe to ask questions and thought the teacher believed in the student's ability to succeed. This helped the student believe in success. The study participants also suggested that support outside the classroom was a comfort in easing anxiety. As the

student's mathematics anxiety reduced, they began to work more independently on the course.

Summary

The research indicates that mathematics anxiety and its repercussions on learning mathematics are significant. Research findings show mathematics anxiety is negatively related to mathematics achievement. The situations related to mathematics anxiety are numerous, and may be as individual as the student. However, research suggests that reduction or coping mechanisms for mathematics anxiety must be known and explored from the point of view of the mathematics anxious student.

The literature shows that mathematics anxiety can affect mathematics achievement. Therefore, reduction in mathematics anxiety will support increases in achievement. If teachers can help students cope, anxiety may also be reduced.

Methodology

Introduction

This qualitative action research study investigated the following question: How do students describe and cope with mathematics anxiety. The qualitative approach gave students the opportunity to explain their ideas and talk about their experiences in the interviews. The section to follow details the study's development.

Rationale for Qualitative Design

Qualitative research design gives the researcher the opportunity to interview, observe, and document data on a unique level. The researcher uses personal experience and understanding of the subject matter to guide and explore in depth with the study participants. When studied in this manner, mathematics anxious students in the classroom can build rapport with the researcher and provide a wealth of information. Many qualitative research features described by Eisner (1997) assisted this investigation of mathematics anxiety in the mathematics classroom. For example, the interview approach in the natural setting allowed students to tell about their mathematics experiences. This study was field focused in the mathematics classroom and appropriately relied on student documents, interviews, and observations as sources of data.

This action research, qualitative study follows the guidelines as purposed by Anderson, Herr, and Nihlen (2007). This is practitioner research that addresses a question focused in the researcher's environment. In this site, a teacher is the practitioner researcher who investigates student anxiety. Anderson et al., provides examples and procedures for such insider research, which include a university professor investigating

her class of pre-service teachers and a teacher examining behavior issues of her 8th – grade class. These authors and researchers provide direction for practitioner research in secondary and college level settings.

Role of the Researcher

A researcher trained in qualitative practices can observe, question, and process the data. Lincoln and Guba (1985) refer to the researcher as the human instrument. The researcher reacts, adapts, examines, processes, clarifies, and explores situations during the investigation. All of these are done simultaneously during data collection. The process, while not perfect, yields useful and interesting data.

When gathering information in the field, the unique qualities of the researcher as an instrument allowed the researcher to gather data and delve deeper into the reasons for the study: mathematics anxiety and coping strategies. The practitioner researcher, the classroom teacher, provided empathy for the subject matter and understood the contextual details of teaching and mathematics. Lastly, the researcher was able to provide an overall comprehension of the subject to produce an intuitive perspective (Eisner, 1997).

It may be difficult to accept the researcher as an insider and as part of the process; however, Marshall and Rossman (1995) state it is imperative to qualitative research for the development of the design, gathering the data, and recognizing the important issues related to teaching mathematics. In the interviews the interpersonal skills and knowledge of the setting of the researcher proved necessary and an important part of the process.

Setting and Data Sources

The data sources are students enrolled in ninth-grade pre-algebra classes. The study participants were five pre-algebra students with fourth-grade or lower math skills as

measured in May 2008 on a standardized test given to the eighth-grade middle school students in the south central part of the United States. These students were enrolled in the high school during the 2008-2009 school year. These ninth-grade students who met the criteria of enrollment in the lower-level pre-algebra classes were invited to participate in the study. The students that voluntarily became participants in the study could not participate without parental/guardian consent. An invitational letter to students and parents described the study, its purpose, and the data collection methods. The student discussed and came to agreement with their parent on whether or not they would like to be involved. After receiving a positive response from the student and a parental signed consent from the five participants, the study and collection of data began.

Individuals with severe disabilities (e.g., mental retardation and autism) were excluded from this study. Also, failure to obtain voluntary informed consent from a student and the student's parent or guardian met criteria for exclusion from the study.

Data Collection Procedures

Permission to conduct this study was obtained from the school district superintendent and the school building principal where the study took place. Permission from the local university's Human Subjects Review Board was also obtained before interviews began. All ethical guidelines were followed as directed by the local board to ensure participant confidentiality and to obtain informed consent.

Observation

Classroom observations during the school day provided a unique way to study the mathematics anxious student in the field. The setting is in the real classroom and provided specific details of student's mathematics anxiety and coping mechanisms. The

researcher took observation notes for verification with the subsequent student interview data. The students' reactions, questions, expressed feelings, and responses to questions focused the observations in the classroom setting (Anderson et al., 2007; Eisner, 1997). Observations took place during May 2009, the last month of the school year.

Interview

The overall research question guided the development of the individual interview questions. Two local university mathematics instructors and two mathematics teachers from the high school reviewed the interview questions. The expert reviewers suggested rewording of questions to meet the student's developmental levels. They also suggested additional questions and deletion some questions. After this refinement, the interview questions were submitted to and approved by the Human Subject's Review Board.

Interview questions were semi-structured and open-ended and included some follow-up detail questions for clarification. Questions with simple yes/no answers were avoided (Spradley, 1979). The questions required thought and were intended to draw out the students' ideas and feelings about mathematics anxiety and coping abilities. The students' perceptions and explanations were the primary focus for the researcher.

The individual interviews were conducted at the students' high school in the student's classroom, with the fewest interruptions. The interviews occurred after the students' grades were posted and the school year had ended. This addressed bias issues that may have emerged if the interviews were conducted during the school year. Consideration was given to the student's preference as to dates and times. All specifics were agreed upon and confirmed with the interviewee and the parent. A signed consent form containing a description of the study and its possible use was obtained from the

student before the interview began. The interviewee was asked permission to make contact with additional follow-up or clarification questions if needed.

The anonymity of the student participant was held in strict confidence. Student participants were reminded they could drop out of the research project at any time and for any reason. Participant comments and perceptions in no way affected their grade in their pre-algebra class. The interview was recorded and transcribed for use in the study.

Documents

Various documents were collected to provide additional insight as related to the research question. Documents most useful to the research project were the student's textbook, workbook, and handouts. The student's own notes, classwork, homework and/or completed projects also proved to be useful documentation.

Methods of Verification

Data verification. Approaches for data verification or trustworthiness were employed. During data collection the researcher used triangulation, maintained a journal, conducted member checks, debriefed with peers, and collected a detailed description of the students, school, and surrounding community (Anderson et al., 2007).

Triangulation. Triangulation of the data occurred by gathering data from three sources: interviews, observations, and documents. Gathering data from different sources helped to answer the research question thoroughly from multiple angles (Anderson et al., 2007). Using triangulation helped to verify that conclusions remain grounded in evidence provided by the participants.

Reflexive journal. From development of the proposal to the final presentation of findings, entries in the reflexive journal served to record information about self and the

methodological steps of the research process. The term *reflexive* specifically refers to the self and the relationship of self, or the researcher, to the evolving project (Lincoln & Guba, 1985). Therefore, the journal includes the researcher's thoughts about the study, the method, and the data. The journal provides the following: a place to review challenges encountered during the study; new ideas about data; personal reflections throughout the study on what happened and the connection to the researcher's values/interests; and sudden insights, which might otherwise become lost (Anderson, et al., 2007).

During the step-by-step methodological progress of the study, the journal acted as a storage place for the following: important ideas as they developed from the data; comments about the research process; categories that emerge during analysis; outlines for ways to report findings; and monitoring personal bias. Entries were written every day after data collection and analysis. Such entries provide a means for tracing and tracking the development of the conclusions from the collected data. In addition the journal provides a place to write down, analyze, and monitor possible researcher bias (Anderson, et al., 2007; Lincoln & Guba, 1985).

Peer debriefing. The researcher began the research project as part of a university class. Peer debriefing was done with these fellow university research students in the class. Fellow researchers offered alternative explanations of data gathered and helped to critique as well as question the researcher about the research steps and possible bias. Peers helped guide the researcher away from personal assumptions and biases and suggested alternative explanations to the researcher's interpretations of the data as a way to help the research justify with examples from the data. Peer debriefing provided an

external check for the researcher. In the late stages of the study, mathematic teachers from the high school and the local professors from the university provided debriefing support (Anderson, et al., 2007).

Member checks. After the interviews were conducted, the researcher provided the transcribed data to the participant for verification of accuracy, changes needed, or additional input (Anderson, et al., 2007). The data were hand-delivered to the participants. The researcher included a short note requesting a signature to verify the contents of the transcribed interview.

Thick description. Details about the community, student group, and the school became the thick description of the contextual background or environment of the study. School and state websites provided this information.

Data Analysis

Analysis of the data began with the May observations and occurred continuously thoughout the write-up of the study's results. Sometimes the first thoughts about the data came during an interview or observation. The researcher remained alert to emerging information that answered the research question. After each observation, interview, and document collection, the researcher transcribed the tape-recorded information, refined observation notes, and selected document information. Identified segments of meaning from the observations, interviews, and document data were separated and put onto individual index cards.

Then the researcher conducted "open coding" which categorized all the information while keeping in mind the research question. The researcher looked at each segment of data and placed the data into a category or created a new category. Next, the

researcher determined how the categories connected or related to one another. This axial coding clumps the categories around more general themes. Lastly, the researcher tried to develop a "story" to tell how the categories answer the research question, which is selective coding (Anderson, et al., 2007; Creswell, 1998). Throughout the analysis the researcher must focus on the research question (Anderson, et al., 2007; Creswell, 1998; Lincoln & Guba, 1985).

Findings

Introduction

The researcher question for this qualitative action research study is: How do students describe and cope with mathematics anxiety? The literature suggests that students' mathematics anxiety occurs in lower-level mathematics classes (Morris, 2007) and the participants of this study are lower-level pre-algebra students.

In 2009, while teaching two lower-level high school mathematics classes, the presence and concern for mathematics anxiety became the topic for this study. More specifically, mathematics anxiety and coping became the topic for this qualitative action research study to fulfill the requirements for an Education Specialist Degree.

The participants in the study chose their individual personal identifying numbers, which were Student 3, Student 10, Student 12, Student 24, and Student 73. From the list of interview questions developed, each student individually answered questions about their experiences, feelings, and perceptions related to the subject of mathematics.

The transcribed interview data were divided into segments and placed on individual index cards. Each card was imprinted with a citation coding identifying the student/card number/interview date. For example, at the end of a student response the citation 10/1/8-25-09 represents a quote from Student 10 found on Card 1 from the interview on 8-25-09. Then the index cards were sorted into meaningful categories by grouping similar topics together. Segments of meaning from the interviews are indicated by notations, which are found as citations within the narratives that follow.

The data collected from the interviews with the mathematic students resulted in several categories: 1) setting and background information; 2) self-image; 3) mathematics

difficulties; 4) successes in mathematics; 5) support for learning; 6) teacher support; and 7) coping techniques. The paragraphs that follow, introduce the school and the students in the study. Each category that emerged from the interviews is reviewed and discussed in relation to the research question.

Setting and Background Information

The high school, where the research took place, is located in a rural community in the south central part of the United States. The school serves over 850 students in Grades 9 through 12. Students enjoy a 20:1 student/teacher ratio. The certified staff averages 10.6 years of teaching experience. The student population comes from families of strong work ethic and primarily from agricultural and industrial work settings. The community is experiencing some economic and industrial growth. Students can also attend technical classes at the county's area technology center.

The students in the study were enrolled in a freshman class. Therefore, the study participants' ages ranged from 13 to 15 years. There were three boys and two girls in the study. One student was Hispanic, another African American, and the final three students were Caucasian. The incoming freshman students were tested and scheduled for the new school year. The school administration determined that students qualifying for READ 180, an intensive reading intervention program, would also be enrolled in 30 minutes of extra mathematics instruction, taught by the researcher. Throughout that year, the students were observed and dialogued with the teacher about their struggles in mathematics. This dialogue prompted the development of the research question. In answering the question, perhaps the study can determine ways of teaching mathematics that lessen anxiety for these students.

Prior to their freshman year, all eighth-grade middle school students were tested in mathematics. The students with the lowest scores were put in one of two special pre-algebra classes at the high school. All the students in this pre-algebra class had mathematics skills that tested at or below the fourth-grade level. The class size cap on these pre-algebra classes was 18 students, which is a smaller number of students compared to regular classes. In addition, the classes met for 30 additional minutes each day and progressed deeper in the subject, but at a slower pace.

When study participants were questioned, "What kinds of mathematics classes have you taken before this pre-algebra class?" All of the study participants stated they had only been enrolled in "seventh-grade, eighth-grade [math]" (10/1/8-25-09), "regular math" (73/1/6-2-09), or "general math" (12/1/6-2-09) classes. No student in the study reported being enrolled in any special mathematics class or additional mathematics instruction. When the students were asked about prior mathematics classes, Student 3 commented, "I took what they told me to take" (3/1/6-2-09). Student 24 agreed, "What they assigned" (24/1/5-29-09).

The students in the study had the advantage of a small class size. However, the students reported no middle school mathematics intervention prior to their freshman year. The students took classes they were told to take.

Self-Image

The following students developed opinions about their academic ability in particular subjects. I asked students questions about their self-perception related to mathematics: (a) How would you describe yourself as a mathematics student? (b) How

do you do in mathematics? and (c) Why do you think you have problems in mathematics? Overwhelmingly, the study participants agreed they were not skilled in mathematics.

When asked to describe themselves as mathematics students, two responses were slightly positive. Student 10 indicated, "I can do good sometimes" (10/2/8-25-09). Student 24 stated, "I did pretty good this year, better then last year" (24/2/5-29-09).

However, the remaining three students were not positive. "I'm not good in math, like I've had an F in math, since like the fifth grade. I've never had an A or a B in math at all" (12/35/6-2-09), Student 12 stated. When describing himself as a mathematics student, Student 73 said, "Not very good. I struggle with math all the time. Nobody in my family really knows how to do math, and I have no help at home" (73/2/6-2-09). Student 12 agreed, "I do horrible in math. And I have ever since like first-grade" (12/2/6-2-09).

Individually, the study participants spoke about times when they had positive feelings in mathematics class. Several situations that made them feel good about mathematics included: earning a high grade on a homework assignment (12/43/6-2-09) or test (10/26/8-25-09); passing the class (10/26/8-25-09); completing problems faster than another student (10/40/8-25-09); and success using hands-on activities (12/3/6-2-09).

Student 24 remembered gaining confidence when, "My grades were better" (24/18/5-29-09). Another student remarked, "My feelings actually changed a lot, um, I've got a lot more out of it this year, than I ever have, um, like I learned how to do fraction[s] a whole lot better" (3/12/6-2-09). Student 73 responded by saying, "It's

gotten a whole lot easier … because of us doing the little boards [individual white board used by students for practice] and stuff" (73/8/6-2-09).

Students with poor self-perceptions relating to mathematics made comments like, "I can't comprehend most of it" (12/5/6-2-09). Student 3 suggested the following:

> I have problems in math, because I just don't really like it. I don't think I'm really good at it, and I don't understand, like I can't get through my head why I have to know all this stuff, besides just the basic stuff. It like confuses me sometimes when I have to learn new stuff, and I think it's because I just really don't like it that much. (3/8/6-2-09)

Clearly, these students did not consider themselves *good* mathematics students. Overall, their self-perceptions and attitudes concerning mathematics were low. However, their statements became more positive only when they spoke of actually experiencing any success in mathematics class.

Mathematics Difficulties

The mathematics difficulties category consisted of two parts. The students spoke about past experiences in mathematics and more current experiences. Three of the interview questions about past and current mathematics learning were stated as follows: (a) Think back to and tell me about the time when mathematics began to be hard or not fun and describe this time. (b) Think about mathematics class now. Think about the beginning in August up to now. Describe how you feel about mathematics. (c) How about quizzes or tests; how do you feel before you take a quiz or test in mathematics?

All the study participants had specific comments about mathematics difficulty prior to entering high school. Four said their biggest challenge was when they entered

the eighth grade. Student 73 said, “The teacher would write down the steps that we had to do, and she never did really explain anything that she gave us at all. I just didn’t understand them” (73/5/6-2-09). Student 24 talked about working hard in the past, but it not paying off. He said, “Well in middle school, ah, my math teacher, like I used to work hard for her for like three quarters of the year, so she only gave me Ds, so I stopped working as hard as I use to” (24/9/5-29-09). Student 10 said, “The teacher would explain it, but not a lot. Like I don’t know how to put it, but I just didn’t learn. It was either she wasn’t gonna explain it good enough, or I just didn’t learn like I do now” (10/6-7/8-25-09). Student 3 remarked as follows:

> Um, me and her [teacher] really didn’t kick it off too well, but like we got better, but I just couldn’t understand anything she was talking about in math like at all. She used those big long words I could not understand. Everybody would ask her like to explain it better, and she wouldn’t really do it. (3/6/6-2-09)

Two other students in the study gave comments from fifth- and seventh-grade mathematics classes. Student 12 referred back to seventh grade and recalled, “Because that’s when we had to start memorizing” (12/4/6-2-09). Student 24 commented about fifth grade, “I had a teacher like supposedly she was good in math, but I didn’t understand the examples and the teaching that she did” (24/5/5-29-09).

In this study the only difficult topic all the students in the study agreed on was solving equations. Difficulty for Student 10 was the solving steps, “The actual solving the equations” (10/22/8-25-09). Student 73’s difficulty was, “Variables. I didn’t do so good with variables, [where] variables [were] on both sides of the equation” (73/11/6-2-09).

Then I asked the study participants to look at our classroom textbook and point to topics that were difficult from our class material. Student 12 pointed directly to solving equations and said, "Now this was hard, solving equations, like when it would have negatives and stuff" (12/11/6-2-09). Student 3 looked and found equations and replied, "I don't know how to do this, solving equations with fractions. Sometimes like I do good on [it] and then it would get harder, but um, I didn't really understand" (3/16/6-2-09). Student 24 searched the textbook and commented, "Um, well, what was that thing where we had to put all the things in the same spot, like all the x's to this side" (24/11/5-29-09). I offered the student the name of the topic - solving equations. The student continued, "But then I got better at it. We kept going over it and then uh, I figured out how to do it by myself" (24/11/5-29-09).

Each of the five students described feeling anxiety about mathematics assessments. Student 73 admitted, "I get nervous because I didn't study, and I don't ever do good on quizzes or tests in math" (73/23/6-2-09). Student 24 said, "I feel nervous sometimes, not really all the time cause like on some quizzes like I know how to do it. Then you give us a quiz and like I forget all the stuff" (24/23/5-29-09). Student 3 commented as follows:

> Well, it just depends on if I knew it well or not, and if I studied or not. And um, and sometimes I feel scared a little bit because I mean I try really hard to do good. Um, so I just get kinda nervous and try to focus, um, I just try to take deep breaths. (3/31/6-2-09)

Student 10 stated flatly, “Nervous. I feel like I’m going to fail it. I feel like I didn’t study enough” (10/34/8-25-09). Student 73 commented, “The worst thing in class could probably be the tests and quizzes.” (73/16/6-2-09). Student 12 stressed as follows:

> I get really nervous, and I think that maybe, through this, I’m going to fail. And uh, the uh, the quizzes and tests were hard because I would always like forget. [I] get so nervous and psych myself out to where I would forget everything that we had done. (12/34/6-2-09)

Three students mentioned difficulty with fractions. With a creased brow, Student 73 claimed, “Fractions, I’m definitely not good with fractions” (73/14/6-2-09). Student 12 elaborated more, “Anything really that had anything to do with fractions was hard. And like the negative numbers with fractions too. That was like, I was pretty much guessing. I really didn’t know it” (12/10/6-2-09). Last, Student 24 declared, “I try to study, but I don’t know. But when I get to school, and like I have this class, like, at the end of the day, and like, I forget by the time I get here” (24/25/5-29-09).

Difficult topics listed by at least two participants included the following: (a) perimeter and area (3/16/6-2-09; 73/12/6-2-09); (b) negative numbers (3/16/6-2-09; 12/10-11/6-2-09); (c) multiplication and division (3/16/6-2-09; 24/7/5-29-09); (d) parallel lines cut by a transversal (3/14/6-2-09; 12/14/6-2-09); and (e) working alone (3/19/6-2-09; 24/16/5-29-09). Also, Student 24 made an interesting comment about working alone. He/she explained, “Difficulty arose when working by myself [long pause], and that’s all, just working by myself. I work better learning from them [classmates]” (24/16/5-29-09).

Other topics of difficulty that were not mentioned by more than one participant were varied: (a) box and whisker charts (12/12/6-2-09); (b) exponents (73/14/6-2-09);

(c) factoring (24/12/5-29-09); (d) graphing coordinates (73/10/6-2-09); (e) percents (3/16/6-2-09); (f) Pythagorean Theorem (3/14/6-2-09); (g) angles and intersections (12/13/6-2-09); and (h) word problems (3/14/6-2-09). Among the single topics mentioned above, the only topic that elicited any comments was word problems. Student 3 started describing specific parts of a word problem. Then clearly frustrated he/she said, "I can't really do like the word problems. I just don't understand them" (3/15/6-2-09).

The students had noticeable past and present difficulties in mathematics. All the students commented on having mathematics struggles prior to entering high school. First, there were strong reactions verbalized on the complexity of solving equations. Second, test and quizzes created additional anxiety for the students. Third, the major concern for the group was working with fractions and solving equations. There were additional mathematic topics that caused specific students additional struggles.

Successes in Mathematics

Study participants were asked to think back over all the mathematics classes they have ever taken focusing on when mathematics was easy or fun. They were asked to describe those experiences. Some participants had to think a few minutes before they could respond, indicating it had been a while.

Everyone who participated in the study commented they enjoyed working mathematics problems on the board the most. Student 10 happily insisted, "I liked going to the board" (10/3/8-25-09). All participants expressed similar statements. One student stated the obvious as follows:

> You like let us go up to the board and stuff. Because we couldn't really like cheat or nothing, so we just did our own stuff. And you would be like nope or yes,

when it was wrong or right. And you would like help us. Doing it on the boards really helped us a lot. (3/4/6-2-09)

The second most successful topic discussed was hands-on learning games. One student shared a suggestion that the games needed to be useful. "Over the years we just played games and stuff, and it didn't help us none" (3/6/6-2-09), said Student 3. This student added that games in the current class helped. Another student remembered a past teacher who used basketball and he/she added, "Whoever got the answer right first, got to shoot the basketball" (73/4/6-2-09). Student 12 remembered working with, "Hands-on Equations" (12/3/6-2-09). Hands-on Equations is a visual and kinesthetic instructional system that gives students a concrete representation for the symbols and processes used in solving equations. Another student described an experience from third grade as follows:

> They were teaching us math and they got out a package of M&Ms. We had to do a little graph and after we got done graphing, we got to eat the M&Ms. It helped on, like us, through the years because it helped teach us to graph. It was kinda fun. (24/3/5-29-09)

All five study participants commented that calculators were fun to work with and made mathematics easier. Student 73 stated, "I was more comfortable doing math with the calculator because you can do fractions on there, exponents, and multiply, add, divide, and subtract numbers, instead of doing it on a piece of paper" (73/19/6-2-09). Student 24 started, "Yea, the calculator helped me a lot, um, like solving big numbers" (24/19/5-29-09). Two other students described using the calculator with ease on "really long or high numbers" (12/27/6-2-09; 10/27/8-25-09). Student 3 said, "With the

calculator I just have to type [it] in really quick and it gives me the answer quick and easy. Like I can't do long division, so I just type it in fast, and I get [it]" (3/24/6-2-09).

Four of the five participants commented on success in solving one-step and some two-step equations (10/17-18/8-25-09; 12/15/6-2-09; 24/13/5-29-09; 73/15/6-2-09). Two students enjoyed graphing and said, "It was easy" (3/17/6-2-09; 24/4, 14/5-29-09). Students also related individual success in the following areas: (a) dividing (10/21/8-25-09), (b) absolute value (10/21/8-25-09), (c) multiplication tables (24/15/5-29-09), (d) area (12/16/6-2-09), and (e) homework (10/31/8-25-09). Two students enjoyed perimeter (3/17/6-2-09; 12/16/6-2-09) and domain/range (3/17/6-2-09; 12/18/6-2-09). Two other students commented on watching short clip videos. Specifically, Student 3 said, "You showing us little video's like on how to do it, because that's not just you doing it; it's someone else doing it, and we compare the two of you, and it helps" (3/22/6-2-09).

There were several general comments about gaining mathematics knowledge. Student 12 said, "Uh, when I know a lot about it or if we spent like a week or two on it, it's kinda easier" (12/38/6-2-09). Student 73 described, "Math was easy whenever I actually knew how to do it" (73/22/6-2-09). Student 12 added, "When I really understood. I can really do those [like terms] really good, so it was like, I couldn't wait to go home and just get my homework done and over with" (12/31-32/6-2-09).

All the students claimed some success in mathematics. The students enjoyed hands-on activities like going to the board to work problems individually or playing mathematics-related games. All five participants agreed that calculators made mathematics easier. Four of the five students had success in the beginning solving equations, specifically, with one-step equations. The comments on gaining mathematics

knowledge suggested they all felt success when they learned the material. As in the mathematics difficulties category, individual students did succeed in particular areas.

Support for Learning

The study participants were asked the following two questions: What other things, people, or situations do you think influence your feelings about mathematics? and When you do your homework, what kinds of problems do you have? The answers given outlined the students' learning support networks. Support for learning came from two sources: home and classmates.

The students offered comments about working alone at home or getting no help at home. Student 3 stated, "I would just completely go blank. Because I had nobody there, like, to help me, like a teacher like you are. When I would be at home by myself, it was hard 'cause I had no help" (3/26/6-2-09). Student 73 proclaimed, "Homework was a big problem, because I usually don't take notes in class and have nobody to help me when I get home" (73/20/6-2-09). Student 3 stated, "My dad, he also doesn't really like math and he's like, you know what, it just doesn't really matter [that] you know it [math]" (3/10/6-2-09). Student 73 could not depend on his family for mathematics help. He stated, "It isn't going to be my family, because they don't know how to do math. I got people in my math class that help me. They help me, whenever I don't know how to do it" (73/7/6-2-09).

Homework wasn't a problem for Student 24 or Student 10 because they finished at school. "We didn't have too much [homework], and I got most of it done in class. I don't have a teacher or a friend to see if I got it right" (24/20/5-29-09), said Student 24. Student 10 said, "I could usually get them done in class" (10/32/8-25-09).

Two students had positive help within the family. Student 12 spoke about help given to her by a mom and a grandma. "My mom because [she's] like explaining everything to me if I don't understand it. She helps. And my grandma helps a lot too, because she is like the person in my family that knows the most about math" (12/6/6-2-09). Student 3 also had help from a grandma. She further explained, "The good influence is my grandma. She is really good at math and whenever I need help she'll like help me. Because I usually go over there and do homework a lot, while I am down there" (3/9/6-2-09). Next, the student mentioned help from a sister. She continued as follows:

> She's really good at math, she's like a really good example of it because she makes like straight good grades. She has those high classes like in math and um, she's older than me and uh, kinda like persuades me to like be like her a little bit in math and try harder. (3/11/6-2-09)

The students talked about how they worked together in class to support each other. Student 12 commented, "We would work together, and like if she [another student] didn't know something, usually I knew it. And if I didn't know something, she usually knew it. So, we just kinda took what we both knew and put it into one" (12/7/6-2-09). Student 3 also commented that students helped each other in class, "They can ask [each other] like show them how we do it, and if you tell them you don't know how to do it, they would say, like, come on I know you can do it" (3/39/6-2-09). Sometimes they supported each other outside the classroom. Student 3 explained, "I would call and ask my friend, and me and her would do them on the phone together and we would tell problems we had and we actually did that" (3/28/6-2-09).

Some students received help from home, all students appreciated the help they

received from their classmates. Starting with the positive, one student had only affirming comments about their home and classmate support. One other student had positive discussion about home and a classmate, but the comments included a negative aspect as well. The other three students received no support or positive influence at home. All the participants said they helped each other during class. They enjoyed working together, and some students even worked together after school.

Teacher Support

Participants were asked a question such as, "What can a teacher do to help you with your mathematics work?" or "What things in class make it easier to learn mathematics or do your classwork?" The teacher support category included six different topics as follows: (a) verbal reinforcement, (b) rewards and incentives, (c) one-on-one help, (d) specific teaching examples, (e) morning tutoring, and (f) class size.

All students in the project agreed on how positive verbal reinforcement and other encouragement from the instructor helped them cope. Student 12 commented, "Like when I would do something right you were like yah, that's good, like you done better in this than that" (12/24/6-2-09). Student 3 said the following:

> You told us that we could do it, you just kept telling us, …kept encouraging us. When you would tell us, *we can do it* [italics added] and [I] felt happy about it. It really encourages us to do it, …you may not think it meant a lot, but it did. [You] help us with our problems and show us or tell us how to do it. (3/23/6-2-09)

When the students were asked how they coped when they were struggling with a concept, Student 73 said, "Uh, you helping us and believing I could do it …that's when I thought I could do it" (73/18/6-2-09).

The students also discussed rewards and incentives as support from the teacher. Student 24 appreciated rewards and interjected, “Um, when I get a problem right, you like give us candy. Um, if we get our work done [or] get a nice total questions correct, you let us go outside” (24/29/5-29-09). Student 10 said, “I didn’t really like math until I got in here. I kinda had fun in this class. [We] went to the board and done different problems” (10/9/8-25-09). Student 12 also liked rewards saying, “You would like reward us with stuff. We would like get to play a game or watch Numbers (a television show that uses math to solve crimes) or something when we do really good on one unit” (12/25/6-2-09).

The students in the study especially appreciated one-on-one help. Student 12 said, “Like, when I didn’t understand something or like, when I was working at a problem, and you saw my first mistake, you would automatically stop me and say, okay, we need to go back and you know, fix this” (12/21/6-2-09). The student continued, “If I didn’t know how to do a problem, you would like, sit there with me and like, from the start of the problem to the end and like, help me work it out” (12/22/6-2-09). Another student expressed liking, “When [the teacher] tells me if I’m doing it right or if I’m doing it wrong, and show[s] me how I need to be doing it” (73/30/6-2-09). Student 73 also remembered an event in seventh grade and shared, “A coach would help me with my homework after football practice” (73/3/6-2-09). Student 3 said, “I got a lot more out of your teaching than in this, because you worked with us a lot more” (3/3/6-2-09). The student continued, “[You] would like help us, um, like when we got in groups and stuff. You would kinda like just walk around and help us and make it make sense to us” (3/5/6-2-09).

Specific teaching examples are another way teachers provided support that helped students. Student 24 commented, "The problems that you got going on in math, yeah, like the examples that you give us. They are really good" (24/30/5-29-09). Student 12 elaborated, "Teachers should, uh, like put something like big words or bigger numbers into the simpler, smaller problems" (12/44/6-2-09). Student 10 explained that teachers should, "Explain it on the board and give problems, …then ask everybody if they knew what they was doing" (10/41/8-25-09). He concluded, "Sometimes you may just go to the board and do a problem" (10/41/8-25-09). Another student enjoyed, "You coming around and teaching us how to do it better, and explaining it" (73/17/6-2-09).

One student stressed the importance of morning tutoring and class size. She said, "I would always have to … come maybe the next day [morning tutoring] or something, and do it when I had help or a friend or a teacher" (12/29/6-2-09). Then the comments changed focus to class size. She continued, "I liked it [the smaller class] better, because like everybody was kinda like behind with me. They weren't all up ahead of me and stuff, and it was smaller and we had like more people to work with too" (12/46/6-2-09). Student 12 ended by saying, "Yeah, it seemed like we got more help, if we needed it" (12/47/6-2-09).

The study participants made many comments about teacher support. All the students appreciated any and all positive verbal communication from their teacher. Four of the five discussed rewards and incentives such as working on the board, playing a mathematics-related game, earning a few minutes of outside free time, or watching a video. The rewards and incentives helped motivate them to do the mathematics work. The students also wanted individual, one-on-one help from the teacher. Another topic

mentioned by four of the five participants was specific teaching examples given by the teacher to support their learning. One student went into detail about how morning tutoring with the teacher and the small class size can support learning.

Coping Techniques

Responses varied when students were asked, "What coping skills do you use that help make mathematics easier for you?" The student's coping techniques had some similarities but just as many differences. All five participants said they could study more and pay more attention in class (3/40/6-2-09, 10/42/8-25-09, 12/45/6-2-09, 24/31/5-29-09, 73/31/6-2-09).

When I asked questions about how they studied, each participant at some point said, "I don't study" (3/36/6-2-09, 10/8/8-25-09, 12/36/6-2-09, 24/24/5-29-09, 73/24/6-2-09). One student admitted she studied but not all the time. Student 73 explained this by saying, "I'm not focused and I don't listen as much as I should" (73/6/6-2-09).

All student participants said mathematics was just "hard" for them. When asked about studying for quizzes or tests the comments varied. Two said they got "nervous" (3/34/6-2-09, 24/24/5-29-09). Others said, "It is hard to concentrate or focus" (3/32/6-2-09, 10/28/8-25-09, 12/19/62-09). Student 12 admitted, "Either I would like forget like the steps to doing it, or I would just like forget how to do it" (12/28/6-2-09).

Interviewed students were asked, "What do you do when you can't work a problem on the test?" All five stated similarly specific responses as follows: "Leave it blank" (10/38/8-25-09, 24/21/5-29-09); "Skip it" (3/36/6-2-09, 12/30/6-2-09, 73/27/6-2-09); or "Guess" (12/41/6-2-09, 24/27/5-29-09, 73/21/5-29-09). Two students commented on using the process of elimination (10/38/8-25-09, 12/40/6-2-09), but Student 12 went

on to say, “[I] try to eliminate which ones I know it’s not, or if they all look right, I just kinda guess at it” (12/40/6-2-09).

Student 73 suggested, “Writing more notes during class would help make math easier” (73/31/6-2-09). Student 3 agreed with the note suggestion and made this comment during his interview, “During class I write notes on my paper of like how to do it. And I like look at that corner or wherever I wrote it, and the notes would like help me a lot” (3/25/6-2-09).

Additionally, Student 12 responded, “I need to work a little more on my multiplication and division and just try to focus more on it, than talking” (12/45/6-2-09). Then the same student noted, “Asking more questions when I don’t understand would help” (12/19/6-2-09). Student 3 suggested, “Try not to forget a lot of the math or look on the Internet for games that help with math” (3/40/6-2-09).

The students explained they tried different techniques to cope with homework. Student 10 commented, “I worked with the problems [answered] out of the back of the book” (10/35/8-25-09). Student 3 furthered explained, “I would go to the back of the book and see if I got the answer right” (3/27/6-2-09). One student called and asked a friend. They worked on the phone together (3/33/6-2-09). The same student claimed, “I would get on the Internet and look up like, what I’m doing, or I would just wait until the next day and ask you” (3/29/6-2-09). Another student admitted, “I try to do it, but if I see that [it] is wrong or think it’s wrong, I just leave it. When I get to class, I try to copy off of a friend” (24/21/5-29-09).

The students coping techniques included as many differences as similarities. All participants agreed they “did not study”; however, for future purposes, they all said they

needed to study and to pay more attention. Agreement among the students also included "math is hard." The difficulty emerged in different forms – getting nervous, losing focus or concentration, and forgetting – but it hindered their progress. All the students had comparable strategies for coping when they encountered mathematics problems they could not work – guess, leave it blank, or skip it entirely. Two students used a process of elimination on mathematics problems they could not work. Different coping mechanisms emerged from students' responses that note taking, practicing mathematics, and asking more questions would help them be more successful in mathematics. Individual student responses resulted in numerous suggestions to increase mathematics success. Checking answers in the back of the book, taking more or better notes, asking a friend, looking on the Internet, playing Internet mathematics games, asking the teacher, and copying off a friend are ways they coped with mathematics stress and increasing success in mathematics.

Conclusions and Discussion

Introduction

The research question: How do students describe and cope with mathematics anxiety? The sections that follow include the conclusions, which explain how the data answers the research question. Discussion and implications follow with comparisons to prior research and contributions to professional practice.

Conclusions

The categories, which helped to answer the posed question, evolved from the interviews. The student's background, self-image, and mathematics difficulties describe the context for the students' anxiety. While they have encountered some success in mathematics, the students' descriptions of support from family and student friends, along with teacher support, explain how students cope with the anxiety.

How students describe anxiety. The students gave some direct comments about feeling anxiety. The students said they could not do well in mathematics, because they couldn't remember concepts, especially when it came to taking tests and quizzes. They said they would go blank and not remember any steps to do the problems. They felt nervous and would just "forget." They said they tried to study but the examples and notes did not make sense once they were home. They talked about avoiding doing mathematic problems because they knew they could not solve them correctly.

More often the students described situations that made them anxious. Study participants spoke of negative mathematics experiences as early as the first grade. Learning new mathematic concepts builds on the mathematics background a student has

today. A poor self-image, as it relates to a student's mathematical knowledge, affects current learning.

When eliciting the self-perception from the participant students in the study, they agreed they were not skilled in mathematics. They offered words like "horrible" and "never" to describe their mathematics understanding. They expressed this kind of discouragement, throughout the interviews. They did not think it would get much better or that it would matter if it improved. This defeat, as found in the interview responses, described the anxiety they felt. From class observations, the students appeared discouraged, but the extent of their discouragement was not known until they explained it in the interviews.

From the difficulties they have encountered in mathematics, they commented about the disappointment and continuing struggle. The main focus of beginning algebra is solving equations, and students said this was their most difficult topic. They disliked variables, negative numbers, and fractions. They had trouble learning and remembering the steps to solve the mathematics problems. They discussed many other related difficulties to solving equations. If students' most difficult topic (solving equations) is also the main topic of pre-algebra, the anxiety is understandable.

In general, the students reported from their perspective that they had not received any special classes or extra tutoring in mathematics, as they progressed through elementary and middle school. According to the students, their lower mathematics abilities had not been acknowledged or managed with school intervention methods. They described hopeless situations.

Their anxiety over testing was readily discussed. They admitted to not studying, possibly as an escape. Not studying is deciding to do nothing. If nothing is done, it can be seen as less of a failure or avoiding failure. If the student does not try, then they cannot fail. This points to the student "giving up." Doing nothing was a coping strategy.

When the students did talk positively about mathematics, these positive activities did not appear to outweigh the past negative experiences and feelings of anxiety persisted. When they talked about not being able to work the present mathematics applications, the past negative perceptions fueled their defeat. They just left answers blank, guessed, or skipped them altogether.

How students cope with anxiety. The students relied mostly on school friends and teacher intervention for coping support. Coping strategies of the study participants can be seen through the support they received from fellow students, teachers, and family. The students helped each other and coached each other to continue trying to move mathematically forward. The students in the lower level class lacked a strong family support for their educational studies, especially in mathematics. Individual students showed very limited coping skills. The interviews suggested they had mostly given up on getting much better in mathematics. They lacked motivation to continue because they "knew" they were not going to succeed. They stopped trying and giving up was their way of coping.

Students could have utilized school-related support activities such as tutoring (before and after school), speaking with a school counselor, and extended school services (ESS) for help in coping, but they did not. They did not have private tutors. They did not try studying with additional textbooks or workbooks to improve success. They did not

practice relaxation techniques or use physical activities or exercise to cope with school stress.

Participants agreed that asking more questions in class, turning in homework on time, talking to the teacher about their difficulties, and additional studying would improve their success in mathematics. Agreement among the students about what would help their anxiety was self-reportedly underutilized by the student. Study participants spoke most of the support they were given inside and outside the class by the classroom teacher. Teacher encouragement went a long way in motivating the students as they coped with their continuing mathematics struggle.

The study participants felt more positive about their abilities when they understood the material. They felt more positive when they received a better grade, passed a test, or were able to work problems independently. These successes helped them cope with their continuing mathematics struggles.

Discussion and Implications

The New Webster's Dictionary (1990) describes *anxiety* as an "Intense dread or apprehension." Anxiety, then, cannot be thought of as helpful to the educational process in general or mathematics learning more specifically. Mathematics anxiety in students must be acknowledged and intervention efforts made to help alleviate it.

When the student reported they did not have additional classes or intervention as they progressed through the grade levels, the school administrators need to find ways to publicize programs and guide students directly to the programs. Since the students reported little or no mathematics support at home, school administrators need to develop homework help programs where students can receive help before or after class. Once the

programs are in place, administrators would need to focus on convincing students to use the programs.

In the classroom, teachers could provide more encouragement to students to help expand their confidence. Teachers can provide lower-level students with hands-on activities and immediate feedback on classwork, so students see success from their effort. Classroom teachers could provide opportunities for students to build confidence through small steps of success.

Findings and Previous Research

The current research had many similarities and some differences to the previously reviewed research. I divided the similarities and differences into the same three categories as the literature review: mathematics and achievement; causes/precursors of mathematics anxiety; and reduction or coping mechanisms.

Mathematics and achievement. Nasser and Birenbaum (2005) found self-efficacy to have the most influence on achievement in mathematics. The current study participants had a poor self-image as related to their mathematics ability and in turn, they had increased anxiety, which affected their progress. This agreed with the Nasser and Birenbaum study.

A study done by Hafner (2008) concluded similar results, to the current study. Participants in both studies exhibited a decline in their mathematics ability beginning in middle school. In Hafner's study the subjects related that it was more difficult to self motivate and that they may give up more quickly, which echoed these students' responses.

In Bonnstetter's (2007) study participants showed increases in achievement over a seven-year time period. These students' scores increased suggesting the teacher's assistance and a positive learning environment helped them improve. Similarly, the pre-algebra student participants spoke of the importance of the teacher's role in supporting the student to move forward positively in mathematics. Bonnstetter's students favored visual, hands-on learning, one-on-one teacher help, along with group work, as did the current study participants. This research, however, did not specifically question the importance of a positive learning environment as Bonnstetter's work did.

In the study by Cates and Rhymer (2003), mathematics performance was linked to the stage of learning. With a higher stage of mathematics learning, the larger the increase in anxiety. Agreeing with Cates and Rhymer, the current study participants spoke of mathematics competencies decreasing as they progressed into higher levels of mathematics classes.

In her meta-analysis study, Ma (1997) found a small relationship between attitude towards mathematics and achievement in mathematics. The relationship did not appear in the elementary grades but could be seen as the students began middle school and progressed to high school. The current study participants did not have a very positive attitude about mathematics, which may have been a factor in their lower performance.

Causes/precursors of mathematics anxiety. Jayaratne's (1987) study suggested a mother's mathematics experiences only affected a child's mathematics experience if the mother had a higher education degree and the child was female. The current study had only one similarity to this (a grandmother who was a child's main source of help and

encouragement). If the grandmother had a degree, the study participant did not mention it.

Green (1990) studied test anxiety, mathematics anxiety and ability, and teacher feedback on mathematics performance. Most interesting was the importance of positive teacher comments on test papers and personalized encouragement. This coincides with the current research, as the students placed a high importance on teacher interaction and positive support as related to their efforts.

Godbey's (1997) study researched symptoms and causes of mathematics anxiety as well as steps to reduce them. Godbey concluded that dedicated teachers, involved parents, and students who will courageously work to solve the problem could reduce mathematics anxiety. However, these students did not have much parent involvement, or seem courageous about working hard in mathematics. That leaves only a dedicated teacher. Godbey suggested that students must learn to ask questions that help them understand the subject matter. These participants thought questioning was one way to improve their success in mathematics.

Reduction or coping mechanisms. Peskoff (2000) focused on 10 mathematic coping strategies and found that students with less mathematics anxiety both utilized and valued a wider array of coping strategies than students with higher mathematics anxiety. The participants in this study undervalued and underutilized coping strategies that worked, but they agreed with Peskoff's study participants who rated and agreed that homework, extra study time, asking questions, and letting the instructor know about difficulties would help them cope with mathematics anxiety.

Study participants in Shields' (2006) work suggested that students learn to take control of their learning and attitudes. Shields offered that anxiety is a learned response that can be unlearned, which is yet to be proven. The students in this study have not and possibly do not know how to take control of their learning and attitudes. At this point anxiety is part of their personal educational story.

To help reduce anxiety, Scarpello (2007) discusses the positive role that parents and teachers can provide. The support and encouragement parents' supply to their students help the student stay engaged and involved in classes like mathematics that may be difficult for the student. In this current study the students reported little help from family, which did not positively benefit them. However, Scarpello (2007) also mentioned the positive influence an instructor can have on a student. The study participants said that the teacher's attitude toward them and the learning environment had a positive affect.

Combining mathematics and art (visual representation) was specifically suggested by Biller (1996) to help decrease anxiety. He also spoke about how important it was to connect mathematics to the real world so students see value in mathematics. The current study participants said they did not think they would get better in mathematics and that it really didn't matter if they did. The students did enjoy active hands-on learning which Biller discusses can also decrease anxiety.

Morris's (2007) study offered what activities student's thought helped them decrease anxiety. Some of the activities they suggested like group learning, asking questions, seeking help outside the classroom, and small repeated successes in mathematics were similar to comments made by the current study participants. However,

knowing something would help and actually participating in the activity is where current students participants fell short. They acknowledged what would help but did not utilize or incorporate the activity into their studying.

Overall, this study agreed with prior findings. The students' perspectives were from various levels in the education process but described similar problems and anxieties.

Contributions to Professional Practice

This action research directly contributes to classroom practices and school leadership. This study created an opportunity for these students to talk about their mathematics difficulties. Students told someone who cared about their anxiety and their coping in mathematics. The students analyzing how and possibly why it occurred. This may give these students a beginning for taking control of their learning.

This research project informs three areas of professional practice. These areas describe the benefits to the researcher as a graduate student, a school leader, and a classroom teacher.

As a graduate student, the specialist project introduced a new tool in studying and evaluating different teaching practices and procedures. This qualitative approach was a new way to think about research, conduct a study, and analyze data. The process provides a completely different way of looking at and deciphering a unique set of circumstances. The process was different from quantitative experiences.

As a school leader, the specialist project provided a unique opportunity to study an important topic that affects students. A school leader must understand the struggles of students and work with teachers to uncover and solve issues that arise.

Personally, as a teacher, the project illuminated the struggles of mathematics students. The comments made by the students suggest approaches that a teacher could or might try to help relieve mathematics anxiety. Teaching practices can encourage students and promote their learning of important mathematics concepts. Teachers must encourage, encourage, and continue to encourage student's successes. Students need to feel successful and build on even the smallest.

At the beginning of the year, teachers may need to help students set learning goals written out on paper. Students need to be prompted to scheduled study time each week, also written the time down. Goals and commitments could be reviewed halfway through a nine-week grading period and at the end of a grading period. Students need to see successful progress in the mathematics classroom.

Relationship building with students is extremely important in the classroom. Students will work harder for a teacher they know cares about them and who they care about. Teachers can involve students in how the classroom is run by discussing and accepting input on class rules and procedures. Lower-level mathematics students could benefit from one-on-one support through additional tutoring. Teacher commitments to stay after school to tutor students in need is a personal decision, but could help students realize that someone cares about their success.

Mathematics classrooms could incorporate activities that involve students in the learning such as hands-on learning activities, computer programs, working mathematics problems on the board alongside peers or at their desks with personal white boards. Teachers can act more as a facilitator to learning, rather than with direct instruction, so students are guided through the concepts they need to learn.

To help build confidence students need immediate feedback as they answer mathematics questions. Adding mini-assessments as students progress over a mathematics concept helps the student see success and guides the student's learning. Encouraging the students and being supportive are what the students wanted from the teachers, so providing a positive learning environment appears essential.

Summary

There is a great responsibility upon the school to identify students who need additional mathematics instruction. One school year of small successes helps but cannot overcome years of prior difficulty in mathematics classes. Students can build on small successes over time, if they are in fact given the time. Special or individual instruction could help them continue to be successful.

Summary

Five students described their mathematics anxiety and coping skills in an action research project. The interviews revealed years of discouragement that affected their mathematics achievement. Many comments about lack of support from home and a student's perceived lack of past support from the school system, and present support from teachers and peers suggest that schools need additional programs for students who seem to rely heavily on support from friends and teachers to succeed in mathematics.

APPENDIX A

Individual Interview Questions

Interviewee # ___

RQ: How do math students describe anxiety and cope with the anxiety?

1. What kinds of math classes have you taken before this pre-algebra class?
2. How would you describe yourself as a math student? (How do you do in math?)
3. Think back over all those math classes you've taken to a time when math was easy or fun. OK, describe that easy or fun time.
4. Think back to and tell me about the time when math began to be hard or not fun. Describe this time.
5. Why do you think you have problems in math?
6. What other things, people, or situations do you think influence your feelings about math?
7. Think about math class now. Think about the beginning in August up to now. Describe how you feel about math.
8. In Pre-Algebra now, tell me about some times in math class that were hard for you.
9. Let's look at specific things about math and talk first about the math textbook (hand textbook to student)

   -Show me in the book what is hard for you. Explain why.

   -What in the textbook do you like or think is easy?
10. Now let's think about work we are doing in class

    -Describe to me things in class that are hard for you.

-What things in class make it easier to learn math or do your classwork?

-What parts of Pre-Algebra helped you gain confidence in your math ability?

-All those calculators hang on the wall, sometimes you all use them sometimes you don't; how comfortable do you feel doing math without a calculator?

11. What about homework?

-When you do your homework what kinds of problems do you have?

-What do you do when you can't work a problem or when it is hard for you?

-Describe what part of your homework is easy.

12. How about quizzes or tests

- How do you feel before you take a quiz or test in math?

-How do you study for quizzes or tests?

-When you take the quiz or test what is hard for you?

-What is easy about quizzes or tests?

-What do you do when you can't work a problem on the test?

13. What are the best things you see going for you in math class?
14. What kinds of situations make you feel good about math?
15. What can a teacher do to help you with your math work?
16. What can you, as the student, do to make math easier for you?

End of Interview.

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